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ABSTRACT

This study investigated the interaction of variations in color realism on pictorial recall memory in order to better understand the effects of variations in color realism, and to draw comparisons between visual recall memory and visual recognition memory in terms of color information processing. Stimulus materials used were three sets of slides, each containing identical images produced in four different visual formats: (1) realistic color photographs; (2) nonrealistic color photographs (created by photographically reversing the color of the original slides); (3) black and white photographs; and (4) line drawings. Subjects were 40 volunteers enrolled in graduate courses in education who were randomly assigned to one of the four treatment groups. A free recall procedure was used. Analyses of the data for the line drawing, black and white, and realistic color treatments suggest that color is superior to black and white visuals, which, in turn, are superior to line drawings. Nonrealistic color, however, was significantly lower than any of the other treatments, indicating that they were substantially more difficult to recall. Examination of the data for the first three treatments demonstrates that, as the variable of visual complexity increases, so does the degree of recall. However, although the nonrealistic color treatment was systematically as visually complex as the realistic color, the additional cues it provided interfered with the recall task by providing irrelevant information. While the results of this study lend credence to the "realism theory" orientation, they do not support the generalized theory of cue summation, which predicts that learning will be increased as the total number of cues increases. (26 references) (BBM)

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THE INTERACTION OF COLOR REALISM AND PICTORIAL RECALL MEMORY

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During the past several years, extensive research has addressed the effects of variations in color realism on visual recognition memory. Few studies have focused on the effects of these color factors on pictorial recall memory. It was the purpose of this study, therefore, to investigate this interaction to: 1. better understand the effects of variations in color realism 2. to draw comparisons between visual recall memory and visual recognition memory in terms of color information processing.

A sizable mass of research has focused on the variable of color in instruction (Dwyer 1972, 1978, 1987; Berry, 1974; Winn, 1976; Chute, 1979; Lamberski, 1980). These investigations addressed one aspect of the larger theoretical debate regarding visual complexity and human information processing. It has long been contended that the mere addition of visual cues will increase the ability of the viewer to store and retrieve visual information.. This orientation, termed "realism theory" by Dwyer (1967), has strong theoretical foundations (Dale, 1946; Morris, 1946; Carpenter, 1953 and Gibson, 1954) and was the notion on which cue summation theory is predicated (Severin, 1967). Other theorists and researchers (Broadbent, 1958, 1965; and Travers, 1964) have argued against this theoretic base on the grounds that the human information processing system is limited in capacity and in times of rapid information reception, irrelevant information may block the processing of other, relevant information. Studies (Kanner, 1968; Katzman and Nyenhuis, 1972; Dwyer, 1972, 1978, 1987) have investigated this apparent inconsistency with contradictory results.

The inclusion or absence of color information can be regarded as one dimension of visual complexity. Color can function in a dual role when used in visual displays. First, it can serve primarily a coding function, providing additional information but not providing any realistic description of the display. In this case, the effectiveness of color can be predicted by cue summation theory, but not by the realism hypothesis. Alternately, color can be used to present a more realistic version of the visual display. In this instance, in addition to providing a greater number of overall cues, it provides the viewer with more

realistic attributes or "handles" with which to store and retrieve information. When color is used in this fashion, its value could be predicted by the realism theories as well as by cue summation theory.

Much past research investigating the differences between color and monochrome visuals failed to take into account the fact that realistic color visuals contain intrinsically more information and consequently require more time for processing. In an attempt to resolve this methodological inconsistency as well as to more accurately assess the role of color in human information processing, Berry (1974) compared realistic and non-realistic color versions of the instructional materials on the human heart developed by Dwyer (1967). Data suggested that, in those learning tasks where visual materials contributed significantly to the improvement of instruction, realistic color materials were most effective. Later research (Berry, 1977, 1982, 1983, 1990) which investigated the color realism/complexity question relative to pictorial recognition memory found both realistic and non-realistic color materials superior to monochrome visuals. These findings suggest that cue summation theory may provide an accurate description of how color functions in basic information processing tasks such as picture recognition.

More limited research has addressed the effects of visual complexity on recall memory. Ritchey (1982) reported an advantage in recall for outline drawings over detailed drawings. A study conducted by Jesky (1984) suggested the superiority of color over black & white and both color and black & white visuals respectively over line drawing images in a recall task. These findings were further confirmed by Alfahad, 1990. Recall memory involving the specific variable of color realism has, however, not been investigated.

METHOD

The stimulus materials used in this study were modified versions of those developed by Jesky (1984). The original materials consisted of three sets of visuals, each produced in three visual formats: line drawing, black & white and color. To create the sets of visuals, three different collections of common household items (32 per set) were randomly arranged on a neutral photo backdrop. In selecting the objects, care was taken to ensure that no verbal labels, names or symbols were visible. Each set was photographed on color slides and then later recopied onto black and white slides. A line drawing of each scene was traced by an artist working from the projected black and white slides. The resulting drawings were also copied onto 35mm slides. In the present study these materials were modified by the creation of a nonrealistic version for each set. This was achieved by photographically reversing the color (realistic) slides of each set so that each color was systematically reversed to it's complementary value.

The color reversal process permitted the overall number of color cues to be held constant, while the degree of color realism was manipulated. In this case, the color cues no longer represented meaningful or familiar attributes of the images, but rather irrelevant visual information. For the purposes of this study, the complete group of materials consisted of three different sets of slides, each containing identical images produced in four different visual formats: line-drawing, monochrome (black & white, realistic color and nonrealistic color.

For presentation purposes, the stimulus materials were organized in a 3 x 4 grid and rotated so that each visual format in each set could be presented to different groups of subjects as shown in table 1.

Table 1
Presentation order of the visual treatments and stimulus sets to the subject groups

	Line Drawing	Black/ White	Realistic Color	Nonrealistic Color
Group 1	Set 1	Set 2	Set 3	—
Group 2	—	Set 1	Set 2	Set 3
Group 3	Set 3	—	Set 1	Set 2
Group 4	Set 2	Set 3	—	Set 1

The research sample consisted of forty students enrolled in graduate and postbaccalaureate courses in education. All subjects were consenting volunteers.and were randomly assigned to one of the four treatment groups.

A free recall procedure was employed in which subjects were presented with the stimulus materials for a brief study time after which they were asked to recall as many items as they could from the stimulus images. The limited capacity of short term memory and rehearsal difficulty predicts that within a brief period of time (approximately four minutes), all items available in memory will have been recalled.

The stimulus materials were presented by means of a Kodak Ektagraphic Carousel slide projector in a semi-darkened room. Projected image size was maintained at four by six feet and subjects were seated in two rows between eight and fourteen feet from the screen. Each subject group viewed an individual slide for a period of 20 seconds after which the slide was removed from view and the lights raised. Subjects then received four minutes to write down as many objects as they could recall from the slide. Prior research, (Salomon & Cohen, 1977) indicated that an exposure time of 20 seconds and a response period of four minutes was adequate time for all subjects to

complete a recall task similar to that employed in this study. This procedure was repeated again with each of the other two slides assigned to the particular group of subjects with a rest period of five minutes provided between each slide A similar procedure was followed with each of the other three groups of subjects.

ANALYSIS

Data obtained from each experimental group was rotated and collapsed under the four respective treatments for purposes of analysis. Although the data could not be analyzed by means of a repeated measures design where every subject receives every treatment, a high degree of redundancy was achieved by means of the rotation procedure. Means and standard deviations for each of the treatment groups are shown in Table 2.

Table 2.
Means and Standard Deviations for Color Treatment groups

Treatment	Mean	S.D.
Line drawing	7.90	1.87
Black & White	9.75	1.72
Realistic color	10.68	2.02
Nonrealistic Color	6.50	1.74

A one-way analysis of variance was performed on the data, resulting in a significant F value ($F=41.31$, $p<.0001$). Post hoc comparisons via the Scheffé method revealed a number of significant pair-wise comparisons. These differences are presented in Table 3.

Table 3.
Summary of Pair-wise Comparisons for Color Treatments

Black & White > Line Drawing
Realistic color > Line Drawing
Line Drawing > Nonrealistic Color
Black & White > Nonrealistic Color
Realistic Color > Nonrealistic Color

DISCUSSION

Data obtained confirm the findings of Jesky (1984) for the line drawing, black & white and realistic color treatments. The additional treatment, nonrealistic color was significantly lower than all other

treatments. This result would indicate that the nonrealistically colored materials were substantially more difficult to recall. Examination of the data demonstrates that as the variable of visual complexity increases, so does the degree of recall. In this case, the most realistic materials (realistic color) were most effective in facilitating visual recall and the least complex (line drawing) were least effective. The nonrealistic color treatment was systematically as visually complex as the realistic color treatment in the total number of visual cues, but did differ in terms of realistic color referents. In this case it can be concluded that the use of nonrealistic color did not aid recall by supplying additional cues, but rather interfered with the recall task by providing irrelevant, possibly distracting information. From this finding, it seems apparent that the factor of visual realism contributes substantially to the recall process by providing familiar, functional cues which aid the learner in retrieving the information. This would seem to imply that the learner has a more generalized schema of the objects which incorporate familiar color codes. When realistic colors are used in the encoding process, these color codes help in retrieving the schemata. In the instance of nonrealistic color, the unfamiliar color cues may inhibit retrieval of the image because they conflict with those which the viewer expects or has instantiated into their cognitive structure.

These findings tend support other research which investigated the effectiveness of realistic and nonrealistic color on a pictorial recognition task (Berry 1982, 1990). In a recognition task, the nonrealistic color cues perform a useful task in providing relevant, although unfamiliar codes used by the viewer in both storage and retrieval processes. In the recall process, the images may be stored based upon shape or verbal labels rather than overall visual cues and consequently are retrieved via a more general schema which does not rely on the unique color cues. To the contrary, these cues may interfere with the process of incorporating the new images into an existing knowledge structure.

The results of this study also lend credence to the "realism theory" orientation, but do not support the generalized theory of cue summation which predicts that learning will be increased as the total number of cues increases. In the case of nonrealistic color, the simple addition of the nonreal cues inhibits rather than facilitates recall of the information.

REFERENCES

Alfahad, F. N., (1990). The interactive effects of cognitive functioning and visual realism on visual memory recall tasks. (Unpublished doctoral dissertation, University of Pittsburgh).

Berry, L.H. (1974). An exploratory study of the relative effectiveness of realistic and non-realistic color in visual instructional materials. (Doctoral dissertation, the Pennsylvania State University). *Dissertation Abstracts International, 35,* 7717a.

Berry, L.H. (1977). *The effects of color realism on pictorial recognition memory.* Paper presented at the annual convention of the Association for Educational Communications and Technology, Miami Beach, FL.

Berry, L.H. (1982). Signal detection analysis of color realism data. *Instructional Communications and Technology Research Reports. 13,*

Berry, L. H. (1983). *The effect of cross cultural variations and color realism on pictorial recognition memory.* Paper presented at the annual convention of the Association for Educational Communications and Technology, New Orleans, LA.

Berry, L. H., (1990). Effects of hemispheric laterality on color information processing. *Perceptual and Motor Skills. 71,* 987-993.

Broadbent, D.E. (1958). *Perception and Communication.* New York: Pergamon Press.

Broadbent, D.E. (1965). Information processing in the nervous system.*Science. 35,* 457-462.

Carpenter, C.R. (1953). A theoretical orientation for instructional film research. *AV Communication Review, 1,* 38-52.

Chute, A.G. (1979). Analysis of the instructional functions of color and monochrome cueing in media presentations. *Educational Communications and Technology Journal. 27,* 251-263.

Dale, E. (1946). *Audio-visual methods in Teaching.* New York: Dryden Press.

Dwyer, F.M. (1967). Adapting visual illustrations for effective learning. *Harvard Educational Review,.37,* 250-263.

Dwyer, F.M. (1972). *A guide for improving visualized instruction..* State College, PA: Learning Services.

Dwyer, F.M. (1978). *Strategies for improving visual learning.* State College, PA: Learning Services.

Dwyer, F. M., (Ed.).(1987) *Enhancing Visualized Instruction - Recommendations for Practice* . State College: Learning Services.

Gibson, J.J. (1954). A theory of pictorial perception. *A V Communications Review. 2,* 2-23.

Jesky, R. (1984). The interactive effects of pictorial presentation and cognitive style on a visual recall memory task (Doctoral

dissertation, University of Pittsburgh, 1985). *Dissertation Abstracts International, 44,* 11077.

Kanner, J.H. (1969). *The instructional effectiveness of color in television: A review of the evidence.* Palo Alto, CA: Stanford University.

Katzman, H. & Nyenhuis, J. (1970). Color vs black and white effects on learning, opinion and attention. *AV Communication Review. 20,* 16-28.

Lamberski, R.J. (1980). *A comprehensive and critical review of the methodology and findings in color investigations.* Paper presented at the annual convention of the Association for Educational Communications and Technology, Denver, CO.

Morris, C.W. (1946). *Signs, language and behavior.* New York: Prentice-Hall.

Ritchey, G. H. (1982). Notes, comments and findings: Pictorial detail and recall in adults and children. *Journal of Experimental Psychology: Learning, Memory and Cognition. 2,* 139-141.

Severin, W. (1967). Another look at cue summation. *AV Communication Review. 15,* 233-245.

Salomon,, G. & Cohen, A. A., (1977). Television formats, mastery of mental skills, and the acquisition of knowledge. *Journal of Educational Psychology. 69.* 612-619.

Travers, R.M.G. (1964). The transmission of information to human receivers. *AV Communication Review. 12,* 373-385.

Winn, W.D. (1976). The structure of multiple free associations towards black and white pictures and color pictures. *AV Communications Review. 24,* 273-293.